DOCUMENT RESUME

ED 072 919 SE 014 131

AUTHOR Stronck, David R.

TITLE The Sociological Backgrounds of Scientifically Talented Secondary School Students Throughout the State of Texas.

PUB DATE Apr 72

NOTE 23p.; Paper presented at the annual meeting of the National Association for Research in Science Teaching (45th, Chicago, Illinois, April 5, 1972)

EDRS PRICE MF-$0.65 HC-$3.29

DESCRIPTORS *Academic Achievement; Educational Research; Parental Background; Science Education; *Secondary School Science; Social Background; *Social Influences; *Student Characteristics; *Talented Students

IDENTIFIERS Research Reports

ABSTRACT

A study on the relationship of sociological conditions to achievement scores is reported for secondary school students in Texas on the basis of the results obtained in the 1971 science contest of the University Interscholastic League. The instruments used were a questionnaire and three tests. The questionnaire included five sociological conditions: the size of school enrollments, the population of the community, the student's selection of future employment goals, and the level of employment and the classification of occupation of the householder. Each test provided 50 questions in biology, chemistry, and physics. Students whose administrators returned questionnaires and scores were divided into the experimental, control, and regional groups as samples. Data analyses demonstrated that larger schools, larger communities, the early selection of careers in scientific fields, and some types of employment held by the householder favored better achievements on science tests. Recommendations were made on consolidation of small high schools. The necessity of sophistication in mathematics to achieve well on tests was also discussed. (CC)

THE SOCIOLOGICAL BACKGROUNDS OF SCIENTIFICALLY TALENTED SECONDARY SCHOOL STUDENTS THROUGHOUT THE STATE OF TEXAS

David R. Stronck
Assistant Professor of Biological Sciences and Education
Washington State University

A paper presented to the Forty-Fifth Annual Meeting of the National Association for Research in Science Teaching, Chicago, Illinois, April 5, 1972

THE SOCIOLOGICAL BACKGROUNDS OF SCIENTIFICALLY TALENTED SECONDARY SCHOOL STUDENTS THROUGHOUT THE STATE OF TEXAS

David R. Stronck
Washington State University

Introduction

The purpose of this study was to analyze the effects of five sociological conditions which are the circumstances of scientifically talented secondary school students throughout the State of Texas. The five sociological conditions selected in this study are (1) the size of the schools enrollment (2) the size of the population of the community in which the student lives (3) the student's selection of a future goal of employment (4) the level of employment, implying the quantity of education required, of the head of the household in which the student lives (5) the classification of occupation, i.e., the field of activity, of the head of the household in which the student lives. This study sought to determine whether or not any or all of these sociological conditions may serve as reliable predictors of scientific talent as demonstrated by reliable and valid achievement tests in science.

The five sociological conditions appeared on a questionaire in the following five questions:

(1) My conference is

1.	AAAA	-	1100 or more students per school
2.	AAA	-	500-1099 students
3.	AA	-	230-499 students
4.	A	-	120-299 students
5.	B	-	119 or fewer students

(2) The size of the community in which I live is

1 a farm or ranch, not in a town
2 under 1,000
3 1,000 to 2,500
4 2,500 to 10,000
5 10,000 to 50,000
6 50,000 to 300,000
7 over 300,000

(3) My future goal is to seek employment in the field of

1 biology
2 chemistry
3 engineering
4 geology
5 mathematics
6 medicine
7 physics
8 a science not listed above
9 a field not listed above

(4) The level of employment of the head of the household in which I live is

1 professional self-employed (most M.D.'s, lawyers, creative artists)
2 professional (most scientists, teachers, accountants)
3 managerial (most supervisors, business executives)
4 small business (most contractors, farm owners, retail dealers)
5 semiprofessional (most welfare workers, foremen, salesmen, technicians, librarians)
6 skilled (most barbers, policemen, clerks, electricians)
7 semiskilled (most taxi drivers, waiters, typists)
8 unskilled (most hospital attendants, laborers)
9 unemployed throughout the last year or retired

(5) The classification of the occupation of the head of the household in which I live is

1 service (counselors, chefs)
2 business contact (promoters, salesmen)
3 organization (accountants, business executives, salesclerks)
4 technology (factory managers, electricians)
5 outdoor (farm owners, lumberjacks)
6 science (researchers, medical technicians)
7 general culture (scholars, editors, librarians)
8 arts and entertainment (athletes, showmen)
9 unemployed throughout the last year or retired

Procedures:

The instruments used in this study were a questionaire and three tests. The same questionaire was administered simultaneously with each of the tests. Each test was a reliable and valid achievement instrument consisting of 50 questions (19 in biology, 19 in chemistry, and 12 in physics).

The tests were used throughout the State of Texas as part of the science contest of the University Interscholastic League (UIL). The Public School Service Bureau of the Extension Division of The University of Texas at Austin orgainzed this activity. Nevertheless, the UIL is completely governed by the administrators of the public schools in Texas. During recent years, approximately 1100 senior high schools have participated in the League's contests.

The present rules for the science contest were established by a committee of science teachers, scientists, and school administrators who met on May 6, 1960, at The University of Texas at Austin. This committee agreed that the science contest should consist of objective questions based largely on a recommended list of books and periodicals. None of these readings are too difficult for bright high school students. The committee hoped that a contest based on readings would allow students of varied backgrounds to compete on equal terms because all of these readings would be readily available. On the other hand, science fairs were criticized because they seem to favor students from homes, schools or communities which have special emphasis on science and provide the

opportunity for extensive laboratory research. Stronck[4] has provided a detailed history of the UIL Science Contest. The rules[2] of the contest and copies of the test may be obtained by writing to the University Interscholastic League in Austin, Texas.

In this paper the three tests will be described as the tests administered to (1) the experimental group (2) the control group and (3) the regional group. The experimental group consists of a sample of 287 students from approximately 1500 students who took the UIL test #50 on the weekend of April 15-16, 1971. The control group is a sample of 281 students from approximately 1500 students who took the UIL test #49 on the weekend of April 1-3, 1971. The sampling depended on the voluntary cooperation of the administrators of the tests. Those who returned questionaires and scores to the researcher provided a random sample of all the students taking that test.

Each high school in the UIL may enter three contestants for the district test. The experimental group received one UIL "district" test while the control group had a different UIL "district" test. No student took both district tests. Two district tests exist to allow the high schools a choice of days for the science test. There are now 196 districts throughout the State of Texas. All schools of the same district are in the same conference. The term "conference" is used in classifying schools by the size of the enrollment. There are five conferences (AAAA, AAA, AA, A, B) according to the average enrollments in grades 9 through 12 inclusively. In the contests of the UIL students compete against

students in other schools of only the same conference.

Participants in the district tests were selected by any method chosen within each high school. Usually they were designated by the chairman of the science department on the basis of their grades. The two students with the highest scores in each district qualified to enter the regional science meet. In this study less than one tenth of those sampled by the district tests appeared again among those in the sample of the regional test. This overlap is small enough to allow the use of the scores on the regional test as a second control group. Because of some overlap and because the regional group is at least 100 students less then either the experimental group or the control group, scores on the regional test will be used in a secondary role for interpreting the data.

Analysis of the Instruments

The University Interscholastic League appointed the following assistant professors of the University of Texas at Austin to serve as the committee for construction of all of the questions used in the tests of this study: Peter R. Antoniewicz, Raymond E. Davis and David R. Stronck. This committee received help from graduate students who reviewed the questions. This collective effort finally produced a series of questions which they judged to be valid questions on the basic concepts of science. Stuart Dattner, supported by a grant from the University of Texas Research Institute, was responsible for the programming of the computer.

All of the tests had high coeficients of reliability: 0.85 for the

experimental group; 0.78 for the control group; 0.86 for the regional group. The means were 27.09, 17.42, and 30.78.

In order to compare the experimental group with the control group, samples from each of these groups were identified by searching for those few individuals from both groups who also repeated the questionaire when they took the regional test. These individuals appeared in both a sample from a district test and the sample from the regional test by random. There was no significant difference in the scores on the regional test achieved by the 27 students who also were in the experimental group and the 22 students who were also in the control group. The t statistic is 1.3107. The control group is therefore truly a reliable group for assisting in the interpretation of other data.

An intensive study was made of the responses to the questionaire of the 49 students who were in the samples of both a district test and the regional test. Table 1 demonstrates that they were not consistent in their responses to each question of the questionaire. This table provides data for only the four questions where there was the greatest disagreement between their responses. The fact that the students were not always consistent requires a cautious interpretation of the questionaire. The demonstrated carelessness of the students does not permit confidence in interpreting data unless the differences in scores are strongly significant. The reliability of these four questions has an average coefficient of reliability of 0.891.

Insert Table 1 here.

The validity of the questionaire was guaranteed by deriving each question from an established source. For example, the list of possible future goals of employment is simply the list of scientifically oriented goals which may be pursued by students at the University of Texas at Austin. The questions on the employment of the head of the household in which the student lives were adapted from the two-way classification of occupations by Anne Roe.[3]

Item analysis of all the questions demonstrated that each subset of questions (biology, chemistry, and physics) as well as each test received a normal distribution of correct answers. Although both the discrimination index and the coefficients of difficulty showed a great variety in the characteristics of typical commercially produced tests.

All of the tests were truly subject-matter achievement tests. Demonstrations of the validity of the tests are described in Table 2. This table clearly indicates that students who did not enrol in a specific science course (biology, chemistry, or physics) had significantly poorer scores on those questions which pertained to that specific science.

Insert Table 2 here.

Moreover table 3 shows the necessity of sophistication in mathematics in order to achieve well on these science tests. Students who had completed only ninth-grade mathematics consistently had the poorest scores.

Increasing the number of years of training in mathematics always increased the average scores of the students.

Insert Table 3 here.

Findings

Tables four through eight describe the relationships between scores achieved on the tests and responses to the questionaire. These tables demonstrate significant differences in scores for each set of students giving a specific answer to the questionaire. Each table presents the finding from a different question.

Table four shows a very simple and consistent pattern: students who attend the high schools with the largest enrollments have the highest scores. The scores progressively decline as the size of the studentbody decreases.

Table five reveals the pattern of scores according to the size of the community in which the student lives. The highest scores were always obtained by students living in communities whose population range from 50,000 to 300,000. Cities of over 300,000 consistently had students in the second rank of scores. Towns of 10,000 to 50,000 produced students of the third rank. In general the trend then continues by which smaller communities have students with lower scores. The lowest scores always came from students who lived in communities of less then 1000 persons. The

second lowest scores were from students residing on a farm or a ranch.

Table six considers the future goal of employment sought by the students. Although the F ratios seem to indicate a definite order, a comparison of the experimental group with the control group gives a coefficient of correlation by the Spearman Rank Order[1] method of only 0.4167. Nevertheless, there are some definite trends to report. Students who have the ambition to become physicists consistently ranked among those averaging scores in highest third. Although future chemists and geologists generally had high scores, there was little stability with the small samples. Students interested in engineering or mathematics had mediocre rankings. Future biologists and physicians usually ranked poorly. The lowest scores consistently came from those who did not intend to seek a career in any of the scientific fields or occupations listed on the questionaire.

Table seven describes the classification of student scores according to the level of employment of the head of the household in which the student lives. Since the head of the household is usually the father of the student, the term "father" is used in the title of the table. The F ratios show a definite ranking; a comparison of the experimental group with the control group gives a coefficient of correlation by the Spearman Rank Order method of 0.6171.

The following trends remain quite evident. If the head of the household has a very high level of educational preparation (which is commonly found among most scientists, teachers, and accountants), the students

have average scores in the highest third of the groups. Contestants from homes where the head of the household is a self-employed professional or a semi-skilled worker (e.g., most taxi drivers, waiters, and typists) or in a managerial occupation (e.g., most supervisors or business executives) have average or better than average scores. Below average scores consistently came from homes where the fathers were in small business (e.g., most contractors, farm owners, and retail dealers). The lowest ranking always went to students from homes where the head of the household was unskilled.

Table eight presents information on students categorized by the classification of the occupation of the head of the household in which the student lives. The classification describes an area or field of occupation without implying any level of educational preparation. Because the head of the household is usually the father of the student, the term "father" is used in the title of the table. Again the F ratios reveal a definite order of ranking. But a comparison of the experimental group with the control group provides a coefficient of correlation by the Spearman Rank Order method of only 0.0238. This very low coefficient implies a random order. In some categories definite trends are obvious. When the father is employed in the fields of science or general culture, the student scored well on the science test. The areas of business contact and organization produce average or better than average scores. Service occupations (e.g., counselor, chefs, etc.) tended to give low scores. The most consistent ranking was last place taken always by

students whose fathers were in outdoor occupations (*e.g.*, farm workers, lumberjacks, etc.)

Discussion

Many aspects of the trends demonstrated by tables four through eight can be explained in terms of sociological conditions found in Texas. A general knowledge of these sociological conditions would suggest many hypotheses for approximately ranking the sets of students. This study provides statistical evidence for supporting such hypotheses.

The first hypothesis is that the scores achieved by students will be directly proportional to the enrolment of the school. Therefore the highest scores will be achieved by students from the largest schools. This hypothesis follows from the fact that each school, regardless of enrolment, may send three students to the district contest. The larger schools must be more selective in their designation of their best three students in science.

Each district may send the two students with the highest scores to the regional contest. The greater selectivity for the regional test might seem capable of obscuring the original strong favoritism for high scores from large schools. But the ranking of students according to the size of the school persists strongly also in the regional contest. In table four the data supports the common presumption that there is better science teaching in the larger schools. Smaller schools may lack teachers who are specialists and a sufficient variety of laboratory materials.

An hypothesis which is greatly dependent upon the previous hypothesis is that higher scores may be expected from students who live in larger communities. Table five supplies data which give strong support to this generalization. Nevertheless, when a city exceeds a population of 300,000, there are somewhat lower scores. The highest scores consistently came from students living in communities of 50,000 to 300,000. This reversal of the sequence seems to conform to the commonly recognized flight of wealthier and more educated persons to the suburbs. Otherwise the pattern is rather stable in providing lower scores from cities of smaller populations.

A third hypothesis is that students with the highest scores will have future goals of employment in those scientific specialties which are taught in the most demanding and difficult high school courses. In most American high schools, physics is the supremely difficult science course taken by only a few seniors who have excellent scholastic records and motivation. Table six shows that students who wish to become physicists consistently have high scores. In recent years there has been declining enrolments in both physics and chemistry. Many small high schools do not offer a course in physics; chemistry in these schools is generally regarded as the most difficult science course. Table six reveals average scores to future chemists as immediately below that of future physicists. Students whose professional interests are in biology or medicine had relatively mediocre scores. Future mathematicians and engineers also had mediocre scores probably because their interests

were not sufficiently concentrated on the detalis of science. Students who did not indicate an interest in any of the fields of science, mathematics, medicine, or engineering, always ranked last. Table six most strongly supports the hypothesis that students without a goal of employment in a scientifically-related field will score below any group of students with these goals.

Another reasonable hypothesis is that in homes where the head of the household has had many years of specialized training to prepare for his occupation, the students will score well on the science test. Table seven well supports this hypothesis. When the head of the household is employed as a professional, the students have high scores. At the other extreme when the head of the household is unskilled, the students always had the lowest scores.

A final hypothesis based on sociological conditions is that in homes where the head of the household is employed in an area which generally demands creative activities, the students will score well on the science test. Table eight provides some support to this hypothesis. Nevertheless one category provided consistent information: if the head of the household worked outdoors, the students scored in the last group.

Summary

This survey demonstrates that larger schools, larger communities, the early selection of careers in certain scientific fields, and some types of employment held by the head of the household favor better

achievement in modern science tests by secondary school students residing in the State of Texas.

The data support the hypothesis that specialized science teachers typically found in larger schools do provide better instruction than that which can be provided in small schools. The high schools with the weakest science programs are in communities of populations ranging below 1,000. Consolidation of small high schools is recommended to improve the scientific opportunities of the students.

Students with the highest achievement on the test were planning for careers in the physical sciences. Students who did not intend to pursue employment in a field of science, engineering, mathematics or medicine, always were in the lowest category of scores on the tests. Interest in scientific careers seems to motivate the students to higher scores on the science test.

The employment of the head of the household in which the student lives sometimes is related to the achievement of the students. If the head of the household has had the many years of educational training required to become a professional, the student will probably have high achievement. On the other hand, if the head of the household is unskilled or employed outdoors, the student probably will have poor achievement on the science test. An environment of scholarship in the home certainly favors higher scores.

REFERENCES

1. Best, John W. *Research in Education.* Prentice-Hall, Englewood Cliffs, N.J., 1959.

2. Bureau of Public School Service, The University of Texas. *Constitution and Contest Rules of the University Interscholastic League for 1970-1971.* Division of Extension, University Station, Austin, Texas, 1970.

3. Roe, Anne. *Psychology of Occupations.* John Wiley and Sons, Inc., New York, 1956.

4. Stronck, David R. "The Science Contest of the University Interscholastic League." *The Texas Science Teacher.* 1 (2): 13-15, 20, 1971.

TABLE 1

The Five Items of the Questionaire with the Poorest Stability of Responses.

	% of Agreement	Pearson Coefficants of Correlation
Future Goals of Employment	86	0.79
Father's Level of Employment	79	0.96
Father's Classification of Occupation	74	0.88
Community's Population	82	0.94

TABLE 2

F-ratios Comparing Scores on Biology, Chemistry or Physics from Students who Enrolled in the Science Course with Those not Enrolled.

Science Course	Experimental Group	Control Group	Regional Group
Biology vs no Biology	4.294*	1.803	4.433*
Chemistry vs no Chemistry	11.590**	12.014**	12.376**
Physics vs no Physics	4.032**	3.647*	6.297**

* Significant at 1%
** Significant at 0.1%

TABLE 3

Mean Scores on the Science Tests Compared with Years of Training in Mathematics.

Students with Mathematics in Grades			Experimental Group	Control Group	Regional Group
9-12		Mean Score	30.0072	19.4222	34.0263
9-12		N	139	101	76
9-11	only	Mean Score	25.5698	17.3625	27.6212
9-11	only	N	86	99	66
9-10	only	Mean Score	22.1667	14.7609	23.5833
9-10	only	N	36	42	12
9	only	Mean Score	19.9375	12.9701	16.1667
9	only	N	16	13	6
F-Ratio			14.604*	7.035*	14.161*

* Significant at 0.1%

TABLE 4

Mean Scores of Students from Schools of Different Enrollments

School's Enrollment	Experimental Group			Control Group			Regional Group			All Groups
	N	Mean	Rank	N	Mean	Rank	N	Mean	Rank	Average Rank
1100 or More	124	31.6774	1	36	23.2222	1	54	38.2778	1	1
500-1099	55	27.2182	2	32	20.0625	2	31	32.0000	2	2
230-499	48	24.1042	3	86	17.1047	3	33	25.4848	4	3.3
120-299	41	19.8780	4	46	15.7609	4	25	26.9600	3	3.7
119 or fewer	14	18.2143	5	67	13.9701	5	30	22.2333	5	5
Total	282			267			173			
F-Ratio	26.813*			14.546*			25.042*			

*Significance at 0.1%

TABLE 5

Mean Scores of Students From Communities of Different Populations.

Population of The Community	Experimental Group			Control Group			Regional Group			All Groups	
	N	Mean	Rank	N	Mean	Rank	N	Mean	Rank	Average Rank	Rank by 7 Categories
Farm or Ranch	30	24.7000	5	56	14.8571	6	30	24.4667	6	5.7	F
Under 1,000	30	20.2333	7	54	14.4259	7	18	24.0556	7	7	G
1,000-2,500	32	22.5000	6	35	17.3429	4	18	26.6667	5	5	E
2,500-10,000	46	24.7391	4	70	17.2286	5	42	30.5000	4	4.3	D
10,000-50,000	39	27.0000	3	23	19.9565	3	20	32.1000	3	3	C
50,000-300,000	61	34.6239	1	12	23.9167	1	30	37.9000	1	1	A
Over 300,000	40	29.4750	2	23	23.1304	2	20	36.7000	2	2	B
Total	278			273			178				
F-ratio	17.368*			8.539*			10.411*				

* Significance at 0.1%

TABLE 6

Mean Scores of Students with Different Employment Goals

Future Yield of Employment	Experimental Group N	Experimental Group Mean	Experimental Group Rank	Control Group N	Control Group Mean	Control Group Rank	Regional Group N	Regional Group Mean	Regional Group Rank	All Groups Average Rank	All Groups Rank By 8 Categories
Biology	26	29.7692	3	28	15.9285	7	13	29.0000	6	5.3	E
Chemistry	21	27.0952	6	19	21.7895	1	20	34.5000	2	3.0	B
Engineering	44	28.6364	5	45	19.2444	4	31	29.6452	5	4.7	D
Geology	3	30.0000	2	3	20.6667	2	2	26.0000	[illegible]	4.0	C
Mathematics	30	24.1333	8	26	16.5000	6	11	31.8182	3	5.7	F
Medicine	63	26.6984	7	42	17.0714	5	33	28.9697	7	6.3	G
Physics	22	32.5455	1	18	19.8889	3	24	37.4583	1	1.7	A
Another Science	19	28.9474	4	16	14.7500	8	11	30.6364	4	5.3	E
Another Field	54	23.3889	9	78	15.7051	9	29	24.4828	9	9	H
Total	282			275			174				
F-ratio	3.445*			2.858*			3.416**				

* Significance at 1%

** Significance at 0.1%

TABLE 7

Mean Scores of Students Whose Fathers have Different Levels of Training For Employment.

Level of Employment	Experimental Group N	Experimental Group Mean	Experimental Group Rank	Control Group N	Control Group Mean	Control Group Rank	Regional Group N	Regional Group Mean	Regional Group Rank	All Groups Average Rank	All Groups Rank by 6 Categories
Self-Employed Professional	13	27.2308	4	15	16.4667	6	12	30.6667	3	4.3	C
Professional	48	30.9583	1	54	19.7593	3	38	35.3421	1	1.7	A
Managerial	62	28.5484	2	35	17.0286	5	39	30.5641	4	3.7	B
Small Business	41	26.0732	6	78	15.7821	8	30	29.1667	6	6.7	D
Semi-Professional	38	27.8421	3	23	21.0000	2	29	28.1724	7	4.0	B
Skilled	41	24.6829	8	40	15.8500	7	9	26.0000	8	7.7	E
Semiskilled	11	26.2727	5	4	22.2500	1	5	29.4000	5	3.7	B
Unskilled	19	20.8947	9	14	12.5714	9	10	24.8000	9	9	F
Unemployed or Retired	10	25.6000	7	10	18.2000	4	6	32.3333	2	4.3	C
Total	283			273			178				
F-ratio	3.190**			3.494***			2.152*				

** Significance at 1% *** Significant at 0.1% * Significance at 5%

TABLE 8

Mean Scores of Students Whose Fathers are in Different Fields

Field of Employment	Experimental Group N	Experimental Group Mean	Experimental Group Rank	Control Group N	Control Group Mean	Control Group Rank	Regional Group N	Regional Group Mean	Regional Group Rank	All Groups Average Rank	All Groups Rank by 5 categories
Service	21	27.4762	5	18	16.1667	7	18	29.6111	6	6.0	D
Business Contact	33	28.9697	2	30	18.3000	4	10	31.5000	5	3.7	B
Organization	63	28.9524	3	49	17.9388	5	40	32.0250	3	3.7	B
Technology	73	27.2877	6	45	20.4000	1	29	29.0345	7	4.7	C
Outdoor	38	21.4474	8	75	14.7200	8	38	26.8158	8	8.0	E
Science	18	30.6667	1	16	17.6250	6	16	36.4375	1	2.7	A
General Culture	17	28.8235	4	15	20.0667	2	12	33.1667	2	2.7	A
Unemployed or Retired	11	26.3636	7	10	18.5000	3	7	31.5714	4	4.7	C
Total	274			258			170				
F-ratio	3.524**			3.413**			2.138 *				

** Significance at 1%

* Significance at 5%